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Jawaharlal Nehru

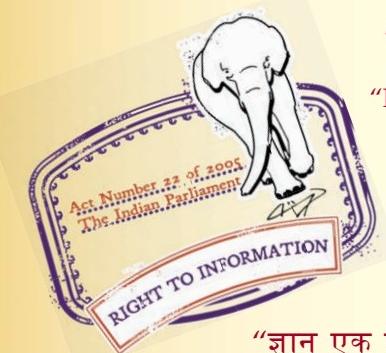
“Step Out From the Old to the New”

IS 9148 (1979): Tape wrapped rectangular and square copper wires with a temperature index of 220 [ETD 33: Winding Wire]

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Satyanaaran Gangaram Pitroda

“Invent a New India Using Knowledge”



**“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”**

Bhartṛhari—Nītiśatakam

“Knowledge is such a treasure which cannot be stolen”





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IS : 9148 - 1979

*Indian Standard*  
SPECIFICATION FOR  
TAPE WRAPPED RECTANGULAR  
AND SQUARE COPPER WIRES WITH  
A TEMPERATURE INDEX OF 220

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INDIAN STANDARDS INSTITUTION  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

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AMENDMENT NO. 1 MARCH 1985

TO

IS:9148-1979 SPECIFICATION FOR TAPE WRAPPED  
RECTANGULAR AND SQUARE COPPER WIRES WITH  
A TEMPERATURE INDEX 220

(*Page 3, clause 1.1*) - Substitute the following  
for the existing clause:

'1.1 This standard relates to polyimide tape, wrapped  
rectangular and square copper conductors suitable  
for temperature index 220'.

(*Page 3, clause 1.2, first line*) - Insert  
'polyimide' in between 'the' and 'tape'.

(ETDC 33)

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Reprography Unit, ISI, New Delhi, India

*Indian Standard*  
SPECIFICATION FOR  
TAPE WRAPPED RECTANGULAR  
AND SQUARE COPPER WIRES WITH  
A TEMPERATURE INDEX OF 220

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( *Continued on page 2* )

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**IS : 9148 - 1979**

( *Continued from page 1* )

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*Indian Standard*  
SPECIFICATION FOR  
TAPE WRAPPED RECTANGULAR  
AND SQUARE COPPER WIRES WITH  
A TEMPERATURE INDEX OF 220

**0. FOREWORD**

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 29 March 1979, after the draft finalized by the Winding Wires Sectional Committee had been approved by the Electrotechnical Division Council.

**0.2** While preparing this standard, assistance has been derived from Doc : 55 (Secretariat) 142 'Second Draft — Specification for particular types of winding wires — Tape wrapped rectangular copper wires with a temperature index of 220' issued by International Electrotechnical Commission.

**0.3** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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**1. SCOPE**

**1.1 General** — This standard relates to tape wrapped rectangular and square copper conductors suitable for temperature index of 220.

**1.2** The tape shall be coated with a suitable adhesive (for example, fluorinated ethylene propylene). After wrapping the covering shall be heat-sealed to form a continuous and adherent sheath.

**1.3 Sizes** — The requirements of this standard are applicable to conductors having thicknesses from 0.80 up to and including 5.6 mm and widths from 2 up to and including 16 mm. A schedule of preferred sizes is given in IS : 6160-1971†.

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\*Rules for rounding off numerical values (*revised*).

†Specification for rectangular conductors for electrical machines.

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**1.4 Grades of Covering —** Three grades of covering are specified:

- a) Fine (F),
- b) Medium (M), and
- c) Thick (T).

In each category, single tape and double tape coverings are specified.

**2. TERMINOLOGY**

**2.0** For the purpose of this standard, the following definitions shall apply.

**2.1 Wire** — The insulated material as received.

**2.2 Conductor** — The bare metal after removal of the covering.

**2.3 Increase in Dimension due to Covering** — The difference between the thickness over the tape covering and the thickness of the conductor.

**2.4 Tolerance** — The permissible divergence of an actual magnitude from that prescribed.

**3. GENERAL TEST CONDITIONS**

**3.1** Unless otherwise specified all tests shall be carried out within a temperature range of 15 to 35°C and a relative humidity range of 45 to 75 percent. Before measurements are made, the specimens shall be preconditioned under these atmospheric conditions for a time sufficient to allow specimens to reach stability.

**3.2** The wire to be tested shall be removed from the packaging in such a way that the wire should not be subjected to tension or unnecessary bends.

**3.3** Before each test sufficient wire shall be discarded to ensure that any damaged wire is not included in the test specimens.

**3.4** When no specific range of sizes is given for a test, the test is applicable to all sizes.

**4. CONDUCTOR**

**4.1** The conductor shall conform to **3.1** of IS : 6160-1971\*.

**5. APPLICATION OF TAPE COVERING**

**5.1 General** — Before covering, the conductor shall be completely free from surface defects like burrs, copper dust, etc.

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\*Specification for rectangular conductors for electrical machines.

### 5.2 Arrangement of Layers

**5.2.1** Either one or two layers of tape may be applied.

**5.2.2** The tape shall be wrapped on the conductor, tightly, evenly and free from creases or wrinkles, with the adhesive on the inside when one side coated.

**5.2.3** The tape shall be applied with an overlap of 45 to 50 percent and when two layers are used they shall be applied in the same direction and displaced by approximately 25 percent of the tape width.

**5.2.4** After wrapping, the tape shall be heat-sealed by suitable means to form an adherent and continuous sheath.

**5.3 Increase in Dimensions due to Covering** — The increase in dimensions due to covering when determined by the method as described in 5.1 of IS : 3855 ( Part II )-1979\* shall lie between the minimum and maximum values given in Table I.

**TABLE I INCREASE IN DIMENSIONS DUE TO COVERING**

GRADE OF COVERING (1)	INCREASE IN DIMENSIONS DUE TO SINGLE TAPE COVERING		INCREASE IN DIMENSIONS DUE TO DOUBLE TAPE COVERING	
	Min (2)	Max (3)	Min (4)	Max (5)
	mm	mm	mm	mm
Fine (F)	0.080	0.160	0.160	0.320
Medium (M)	0.150	0.250	0.300	0.500
Thick (T)	0.240	0.360	0.480	0.720

**NOTE** — The overall dimensions shall not exceed the maximum dimensions permitted for the conductor plus maximum values.

### 5.4 Flexibility and Adherence

**5.4.1 Flexibility ( Mandrel Winding Test )** — The covering shall show no opening or delamination when bent on the edge and on the flat around a mandrel having a diameter 4 times the width and thickness respectively.

**5.4.2 Adherence** — A specimen of the wire, 200 to 250 mm long, shall be clamped between the grips of testing machine. The covering shall

\*Specification for rectangular and square enamelled copper conductors: Part II Methods of tests ( first revision ).

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be cut through circumferentially at a point approximately half way along the measured length. The wire shall be stretched 15 percent for single covering and 10 percent for double covering at a rate of 1 to 5 mm/s.

The distance of loss of adhesion shall be less than the conductor width.

**5.5 Heat Shock** — The covering shall show no opening or delamination when prepared as described in **5.4.1** and subjected to a temperature of 240 to 245°C for 30 minutes.

NOTE — The requirements of delamination test are under consideration

**5.6 Breakdown Voltage** — The breakdown voltage test shall be carried out in accordance with Appendix A on five samples. At least four out of the five samples tested shall not breakdown at voltages less than those given in Table 2 and the fifth sample shall not breakdown at the voltage less than 50 percent of the value specified.

TABLE 2 BREAKDOWN VOLTAGE

GRADE OF COVERING (1)	NOMINAL CONDUCTOR THICKNESS		BREAKDOWN VOLTAGE, Min	
	Over (2)	Up to and Including (3)	Single Tape (4)	Double Tape (5)
Fine (F)	mm	mm	V ( rms ) 2 000	V ( rms ) 3 000
Medium (M)	—	2 500	3 000	5 000
Thick (T)			4 000	7 000
Fine (F)			1 500	2 500
Medium (M)	2.500	5 600	2 300	3 500
Thick (T)			3 000	5 000

## A P P E N D I X A

( Clause 5.6 )

### BREAKDOWN VOLTAGE

#### A-1. TEST VOLTAGE

**A-1.1** The test voltage shall be alternating and of a nominal frequency of 50 Hz and approximately sinusoidal, the peak factor being within the limits of  $\sqrt{2} \pm 5$  percent ( 1.34 to 1.49 ). The test transformer should have a rating of at least 500 VA and should provide a current of essentially undisturbed waveform under test conditions. The test transformer shall have a trip current setting of not more than 5 mA.

**A-1.2** The voltage is applied at zero and increased at a uniform rate of approximately 100 V per second until breakdown occurs. In the event of breakdown occurring in less than 5 seconds the rate of increase of voltage shall be reduced. Where the breakdown voltage is equal to or greater than 2 500 V, the rate of rise of voltage shall be 500 V per second.

#### A-2. METHOD

**A-2.1** A specimen of wire 350 mm long shall have the tape removed at one end and be bent flatwise around a mandrel as shown in Fig. 1.

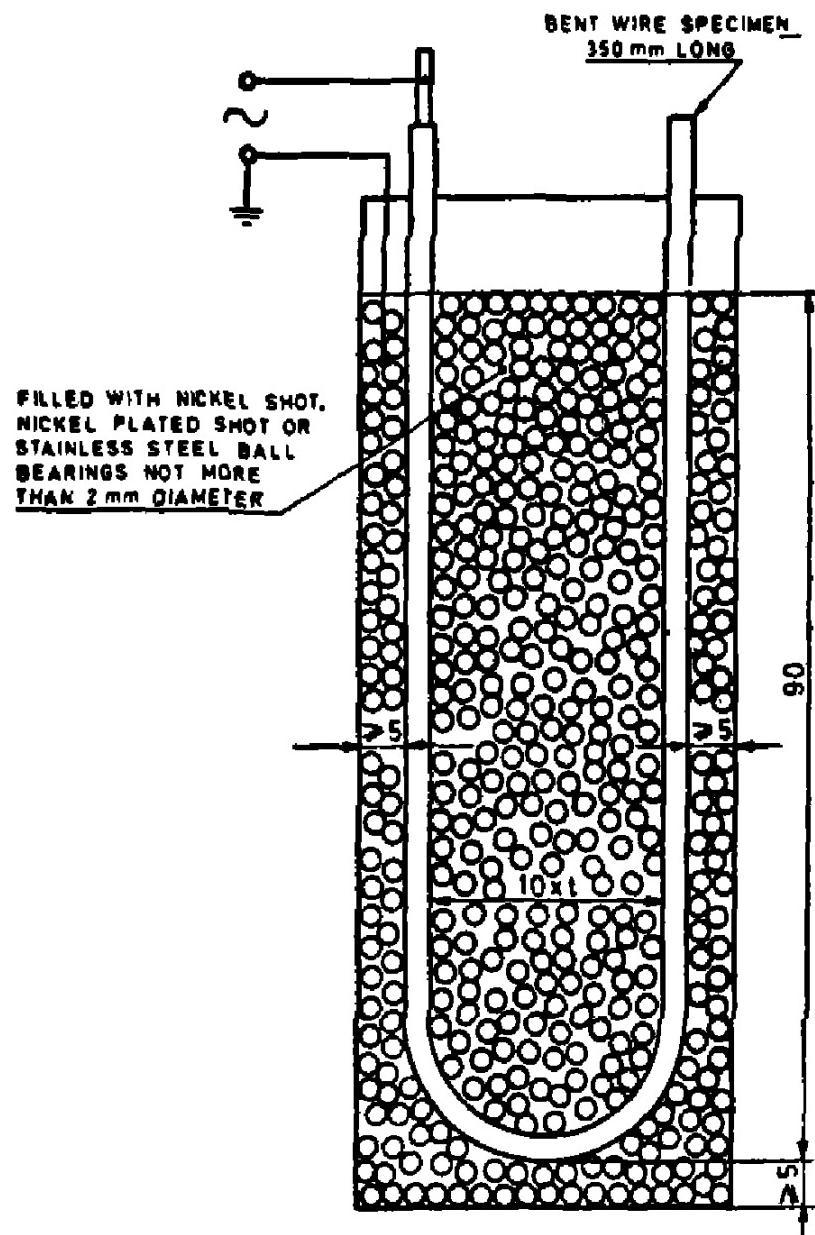
The radius of the mandrel shall be:

25 mm for wires with thicknesses up to and including 2.5 mm, and  
50 mm for wires with thicknesses over 2.5 mm.

The test specimen shall be immersed in a metal container which shall be filled, as shown in Fig. 1, with nickel shot, nickelplated shot or stainless steel ball bearings not more than 2.0 mm in diameter maintained in a clean condition by washing it, for example, in trichloroethylene.

**A-2.2** The test voltage shall be applied between the bare conductor and metal shots ( which are earthed ).

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$t$  = nominal thickness of tape wrapped copper conductor.

All dimensions in millimetres.

FIG. 1 ARRANGEMENT FOR BREAKDOWN VOLTAGE TEST  
USING SHOT BATH

## INTERNATIONAL SYSTEM OF UNITS ( SI UNITS )

### Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

### Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

### Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg m/s <sup>2</sup>
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m <sup>2</sup>
Frequency	hertz	Hz	1 Hz = 1 c/s (s <sup>-1</sup> )
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m <sup>2</sup>

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